

TORNADO AT VERNON, CALIF., MARCH 15, 1930

By MARION E. DICE, General Petroleum Corporation

On Saturday, March 15, a tornado of small proportions traveled northeastward from some point on the California coast through Hawthorne and parts of Los Angeles and blew itself out just north of the Vernon Refinery of the General Petroleum Corporation. It skirted the refinery property at Thirty-seventh and Santa Fe, destroyed a storage shed immediately across the street from the refinery, damaged the Southern Glass Co. plant at 2501 East Twenty-sixth Street, and ended in the river bottom south of Boyle Heights.

The storm was sufficiently close to us for interesting observation without danger.

According to newspaper accounts the tornado first reached destructive proportions at Lawndale and Hawthorne, where light structures were unroofed and trees were uprooted. It continued along a northeasterly path. From time to time the funnel lifted from the earth, so that portions of the path escaped damage. After lifting for a few moments, it attained higher angular velocities and returned to the ground. When it reached the deflecting barrier of Boyle Heights the spin was sufficiently decreased so that the tornado lifted again and did not reform. The hills of Monterey Park and the Sierra Madre Mountains probably had a large effect in destroying the instability of the air currents and checking the storm.

The path of the tornado was quite narrow. Press reports stated it to be only 60 to 70 feet. This figure amply describes it near Thirty-seventh Street, but it widened to about 250 feet just before the whirl stopped. Persons who followed the tornado by automobile gave its velocity along the path as about 15 miles per hour. The known length of the path was about 16 miles. Two persons were reported injured by falling objects. Several others were bruised by being blown violently about. There were no fatalities. Property damage was estimated at \$20,000.

The attention of Vernon employees was first drawn to it about 11:40 a. m. by a whirl of debris to the southwest, accompanied by a roaring sound like that of heavy railroad traffic. One could see fragments of billboard posters, roofing paper, galvanized iron, and other loose debris in the whirl.

The center of the storm crossed Thirty-seventh Street at a point between Santa Fe Avenue and the Santa Fe Railroad. A galvanized-iron storage shed on Thirty-seventh Street in the rear of the Machinists' Tool & Supply Co.'s building exploded and was completely wrecked.

The direction of rotation, as seen from above on a horizontal plane, was counterclockwise. This is always the case in the Northern Hemisphere.

The storm was capped by a tremendous cumulus cloud which gave unmistakable evidence of large upward air currents. These general conditions persisted throughout the day and produced thunderstorms in the afternoon. The base of the general storm cloud was 2,500 to 3,000 feet above the earth, as near as could be judged by comparison with the height of surface structures. The cloud was slate gray, not much different from the under surface of the cumulo-nimbus of a rain squall or thunderstorm. While the funnel cloud was visible, the portions of the main cloud near it were seen to be in turbulence, although there was not the ominous greenish black appearance, with violent boiling and rolling, usually reported by tornado observers.

The funnel cloud was clearly defined north of Vernon. It was white, plainly visible against the dark storm cloud

background. The white portion did not extend to the ground, the lower end of the whirl being marked only by flying debris. The lower end of the white portion seemed to dip suddenly lower from time to time and then to rise again. This was caused by pressure fluctuations in the center. Although the general movement of air within it was upward, sudden diminutions of pressure caused condensation to take place at lower levels and thus made visible the funnel dipping toward the earth.

If the entire whirl had been visible it probably would have resembled an hourglass, with the smallest cross section at some distance above the earth. The bottom of the visible funnel appeared noticeably smaller than the whirl of debris on the ground. This impression may have been faulty due to perspective or to the tendency for the eye to report dimensions near the earth, where comparisons are possible, as larger than the same dimensions in the air.

The diameter of the whirl of material near the glass plant was 200 to 250 feet. It was intermediate between the diameters of the two gas holders of the Southern California Gas Co., which are visible from the department of tests. These holders are 177 and 273 feet in diameter. The height to which flying material extended in the whirl was two or three times the diameter of the whirl, or roughly 600 feet.

After the tornado reached Thirty-seventh Street, where our observations began, it did not appear to move in a straight line. The vortex seemed to sway from side to side as it progressed, hesitating at times and skipping quickly at other times.

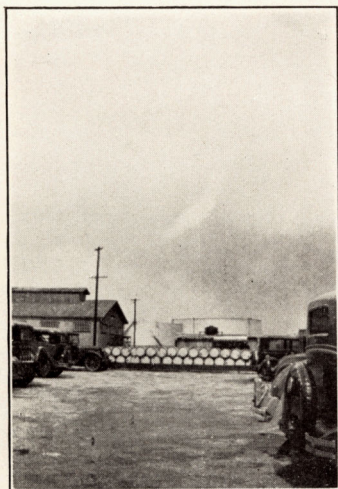
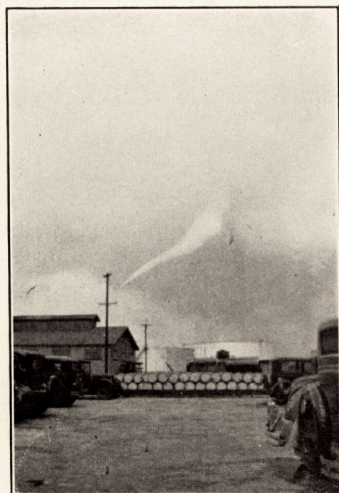
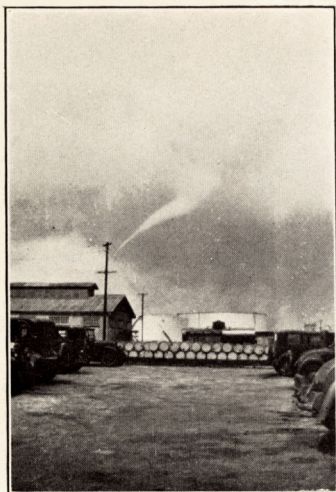
As a general rule, all the characteristics of a violent thundershower accompany the passing of a tornado. In this instance, however, no lightning was seen from Vernon at the time of the tornado. A thundershower occurred later in the afternoon. Hail and rain fell to the northwest of the path only. The usual tornado reports attribute a lurid reddish appearance to the main cloud. This color is probably due to lightning flashes within the cloud. It was not observed at Vernon. The usual reports also mention a yellow or brownish color in the bottom portion of the funnel, due to dust, with a white portion above. The dust colors were absent at Vernon because of the heavy rains of Friday night.

By watching spectators as they caught their first glimpse of the storm, one could immediately sort out the middle westerners from the native sons. Californians, most of whom had never seen a tornado, watched it with no thought of danger, while more experienced Kansans and Iowans were casting about for convenient shelters into which to dive if the whirl came closer.

Tornadoes are uncommon west of the Rocky Mountains although small waterspouts are seen on the southern California coast on an average of one or two days per year. These occasionally sweep a few miles inland, becoming tornadoes. The last previous tornado in Los Angeles was reported in 1921.

Meteorological conditions of this storm.—The weather map of 5 a. m., March 15 (not reproduced), showed three low-pressure areas controlling the weather in California. The first was centered off the coast northwest of San Francisco, the second south of Los Angeles and west of Lower California, and the third in central Nevada.

The wind at Vernon was from the east and northeast all morning. Rain had fallen during the night. The weather during the morning was unsettled, but without rain. The circulation was obviously controlled by low



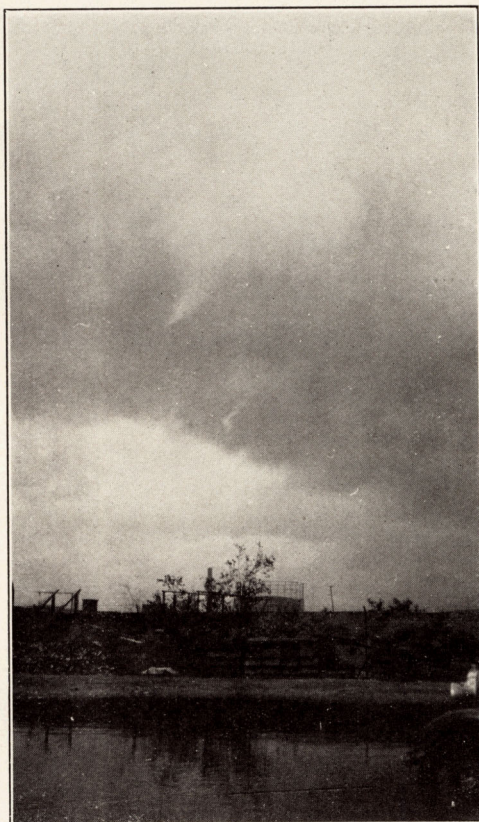
FIGURES 1, 2, AND 3.—A sequence of three views of the funnel cloud taken by Mr. H. B. Hensel, looking northward from the personnel department automobile park. The third view was taken just as the funnel broke up



FIGURE 1A



FIGURE 2A



FIGURES 1A, 2A, AND 3A.—A sequence of three photographs taken from the department of tests by Mr. Donald E. Dickey. These show the first and most spectacular stage of the tornado north of Vernon. The funnel disappeared after 3A was taken



FIGURE 4.—Looking north along the Santa Fe Railroad from Thirty-seventh Street. Photograph by Mr. L. F. Knox, who said the visible funnel extended almost to the ground just before the picture, but seemed to pull up quickly into the air before he could snap the shutter. The time was about 11.40 a. m.

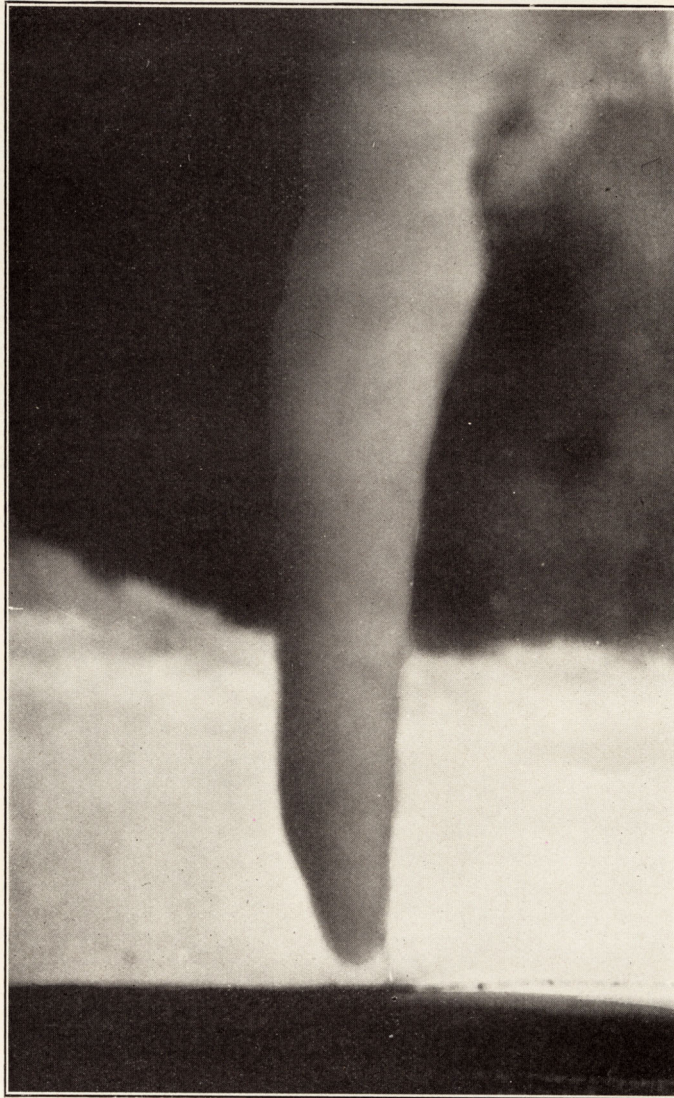


FIGURE 1.—Tornado funnel cloud photographed by Ira B. Blackstock about 4.30 p. m. June 2, 1929, at Hardtner, Kans.

No. 2. The circulation about lows 1 and 3 would produce west winds at Los Angeles, opposing those of No. 2. Evidently there was a conflict of wind systems during the morning, one bringing cold air from the desert and the other warmer, moisture-laden air from the ocean. Surface wind vanes did not indicate any reversal of direction during the morning, but one of our photographs,

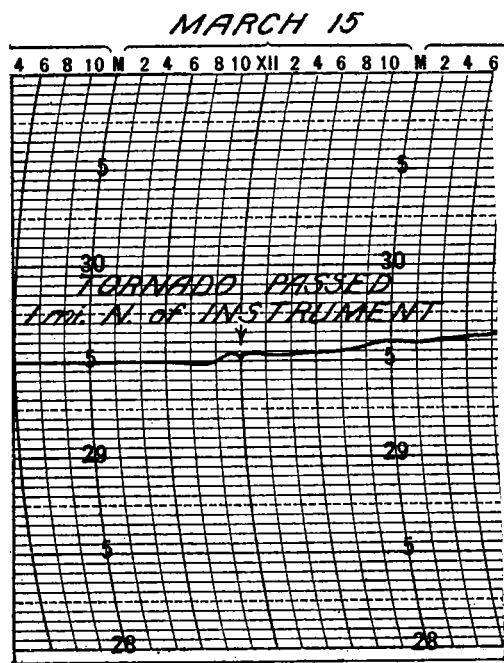


FIGURE 5.—Barograph record at Vernon, Calif., March 15

taken a few minutes after the tornado passed, showed in the cloud formation a pronounced movement upward and from west to east, as opposed to the surface wind from east to west. Apparently the tornado occurred on the wind-shift line. Perhaps the fact that surface winds did not shift was a factor in limiting the intensity of the surface whirl. The chief wind changes were aloft.

THE HARDTNER (KANS.) TORNADO OF JUNE 2, 1929¹

By IRA B. BLACKSTOCK

The tornado at Hardtner, Kans., was observed under very favorable conditions of light about 4:30 p. m. Sunday, June 2, 1929, and was photographed at that time. (See fig. 1.) There was no scattering of debris during the storm or afterwards other than that caused by the contact of the funnel cloud with the earth as it passed across country.

The wind came from south or perhaps a little southwest of Hardtner and then from a northeasterly or perhaps more of an easterly direction. Large hail preceded the storm by several miles and there was a light rain and a very strong rumbling noise associated with the passing of the tornado. The temperature in the morning was 75° at 9 o'clock, 90° at noon, and 95° at 3 p. m. There was a considerable fall in the temperature. The tornado cloud from which the funnel was pendent was of a dirty dark-brown color and extended about 10 miles east-west and 1½ miles north-south. There was practically no lightning. The top of the funnel was perhaps 2 city blocks or more wide and the bottom where it touched the ground did not seem to be over 150 feet wide.

The whirling of the funnel cloud was clearly visible from the top where it joined the main cloud all the way down to where it made contact with the earth.

Wind and temperature conditions were conducive of upward currents, indicative of squalls and thunderstorms. The centers of all three lows were at very low pressures (29.4, 29.4, 29.5 inches), affording general cyclonic movements of considerable intensity.

Rain began at the Los Angeles Weather Bureau (Sixth and Main Streets) at 11:10 a. m., rain and hail at 11:23; hail stopped at 11:40, rain at 11:50. Lightning and thunder were observed. No rain or hail fell at Vernon during this time, although thunder was heard. The Vernon observations were made at a point 2.8 miles S. 33° E. from the Los Angeles Weather Bureau.

The tornado passed within a mile of the barograph at the department of tests in Vernon. Figure 5, the barograph curve showed only a weak pressure drop, indicating that the tornado was not a severe one, although the instrumental effects were of quite definite tornadic character. The barograph had been reading 29.50 inches of mercury during the rain of Friday afternoon and night and until 8:30 a. m. on Saturday. It rose slowly to 29.55 at 11 a. m. and held there until about the time of the storm, when it fell to 29.53 and then rose again to 29.55 by 12:15 p. m. The observed pressure drop of 0.02 inch, followed by an equal rise, was no greater than that due to a moving thunderstorm of the type well known in the Middle West and East. Air temperature and wind velocities were not measured at Vernon. The wind was estimated at less than 10 miles per hour outside the direct path of the tornado, where velocities of perhaps 40 or 50 miles were attained.

No rain fell in Vernon until about 3 p. m., after which intermittent rain with thunder continued until late in the evening.

REFERENCES

- (1) Finley, Tornadoes, New York, 1887. Ferrel, A Popular Treatise of the Winds, New York, 1889. Although these books are old, they contain the detailed discussions of tornadoes which are the basis of standard works of the present day.
- (2) Humphreys, Physics of the Air, Philadelphia, 1920.
- (3) Milham, Meteorology, New York, 1925.
- (4) A. J. Henry et al., Weather Forecasting in the United States, U. S. Weather Bureau, 1916.

Little damage was done perhaps due to the fact that the storm was a dying one and its path was through comparatively thinly settled country.²

Two small dwelling houses were twisted partially from their foundations and a number of barns and sheds also were slightly damaged; wheat fields in the path of the tornado suffered considerable damage.

The approach of the tornado was clearly seen and I was able to make a kodak snapshot of the funnel cloud at a distance of less than a mile from its path; quite a number of others also snapped pictures of it because it was easy to do so. Almost every farm in Kansas is provided with a storm cave or cellar just outside of the dwelling house so that one can be brave and courageous with one foot on the stairway to the cave, quickly snap his or her kodak and then duck to safety. (There were several of us in the cave on the occasion of this storm.)

¹ Credit for bringing the attention of the U. S. Weather Bureau to this tornado belongs to Dr. David White, home secretary, National Academy of Sciences, Washington, D. C., who received a copy of the print reproduced as Figure 1 and brought it to the attention of the bureau. The print was used as a front cover illustration of Science News-Letter of July 19, 1930. Mr. Blackstock has furnished a report on the storm from which the text following has been condensed.—Ed.

² The cyclonic storm that gave rise to the tornado was centered over southeastern Colorado on the morning of June 2. Its normal northeastward movement was prevented by a strong area of high pressure over Lake Superior and it disappeared during June 2 over Kansas. It may be that the lack of violence displayed by the tornado was in a measure due to the disappearance of the original cyclonic storm as just stated.—Ed.